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SYNOPTIC AND CHEMICAL EVOLUTION OF THE ANTARCTIC VORTEX
IN WINTER AND SPRING, 1987

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It is demonstrated that the dynamical evolution of the vortex at least up to 50 mb is dominated by synoptic scales in the troposphere. In particular, there is a clear response when poleward extension of tropospheric anticyclones from latitudes of 40°-50°S to 70°-80°S occurs. This response is evident in isentropic potential vorticity maps, TOMS ozone fields and SAM II polar stratospheric clouds.

An important feature of the high latitude southern hemisphere lower stratosphere is a transition at potential temperatures in the 390-400K range. This transition, the "vortopause", is clearly marked in aircraft profiles of O_3 , H_2O , N_2O and ClO at latitudes 68°-72°S near the Antarctic peninsula, and also over Punta Arenas (53°S). The transition is evident in meteorological cross-sections of potential vorticity and potential temperature; above it, the isopleths are more closely spaced than below it.

The aircraft measurements of H_2O , O_3 , NO_y , N_2O , ClO , and whole air data are examined in "material coordinates", θ and P_θ , backed up by trajectory analysis. The evolution of the chemical mixing ratios is examined in these coordinates as a function of time from mid-August to late September. Conclusions are drawn about the rates of change and their causes.

The meteorological and aircraft data are examined for evidence of the following kinds of motion with respect to the vortex: ingress of air aloft, subsidence, peeling off of air to lower latitudes, and folding of the vortopause.

Conclusions are presented regarding the evidence for a chemical sink of ozone above and below $\theta = 400K$, and whether the vortex has a mass flow through it, or if the chemical sink operates on a fixed mass of air. Implications for mid-latitudes are briefly considered in the light of the conclusions.

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